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(54) **Title:** EXPANDED THERMOPLASTIC SURFACE LAYER FOR COMPOSITE STRIPS

(57) **Abstract:** A composite strip configured as a weatherseal according to the present invention includes a surface layer of expanded thermoplastic having an original cellular structure and a color selected to match an adjacent environment. In a first configuration, the original cellular structure of the foamed thermoplastic has been compressed, while maintaining the relative flexibility of the weatherseal.

EXPANDED THERMOPLASTIC SURFACE LAYER FOR COMPOSITE STRIPS

Field of the Invention

The present invention relates to composite strips, and more particularly to composite strips which may include a trim or a seal portion having an expanded thermoplastic surface layer.

Background of the Invention

Prior composite strips include weatherseals which must perform many functions including the prevention of various contaminants such as moisture, dirt and debris from passing the seal. In motor vehicle applications, the weatherseal must also prevent road, engine, and wind noise from penetrating into a passenger compartment. Additionally, the weatherseal may include trim portions which consumers often demand be of a color to match the vehicle.

In the motor industry, it is common practice to extrude sealing sections either from a black thermosetting polymeric material which incorporates one or more fillers, or from a more expensive thermoplastics material. However, in each case, there is often a requirement for the extrusion to have its characteristics changed. For example, in order to stiffen the thermosetting polymeric material of a U-sectioned edge trim or door seal, a metallic carrier is incorporated within the extrusion. Alternatively (or additionally) a second polymeric material can be co-extruded with the first polymeric material.

In addition to the requirement in the motor industry for extrusions or moldings to color match to the vehicle or paintwork and/or upholstery, the seals must often have a special decorative surface.

In addition, the weatherseal must not only be designed to properly interact with the vehicle and any associated vehicle trim, but it must also be easily installable. An improper seal fit can impair the functioning of the weatherseal in a variety of areas. Low seal attachment effort is necessary to expedite vehicle assembly, while seal extraction effort must be sufficiently great to provide seal retention and to prevent seal disengagement during usage. Low seal attachment

effort is particularly important because it facilitates proper installation of the weatherseal with respect to associated vehicle components.

Unfortunately, these multi component, multi layer or composite weatherseals have a greater rigidity than single material weatherseals. The increased rigidity increases the difficulty in installing the seals. Therefore, the required time for installation increases, which in turn increases the cost and the risk of improper installation.

Therefore, the need exists for a weatherseal having improved handling characteristics while maintaining the necessary sealing performance. The need also exists for a seal that can have selectively colored portions, yet provide enhanced flexibility for assisting installation. A need also exists for a weatherseal that can include multiple components having different performance characteristics, with reduced material and weight parameters. The need also exists for a weatherseal that can employ the aesthetic benefits of a thermoplastic surface layer and still provide ease of handling and installation of traditional single component rubber weatherseals.

Summary of the Invention

The present invention provides a multi-layered, or composite strip, with a thermoplastic surface layer having enhanced flexibility. The increased flexibility provides significant advantages during installation procedures as well as improving conformance of the composite strip to the relevant confronting surface. The present composite strip encompasses extrusions, moldings, trim pieces, edge pieces and seals including weatherseals.

Thus, the present composite strip may be used as a weatherseal in structural sealing applications including residential and commercial buildings as well as the motor vehicle industry. With respect to the motor vehicle industry, a weatherseal configuration of the composite strip is suitable for use in many areas including, but not limited to, door seals, roof rails, deck lids, hood to cowl seals, window seals, sun roof seals or window channel seals. In particular, the present invention finds application in combined seal and edge trims, wherein a composite strip configured as a weatherseal includes a trim portion having the expanded thermoplastic surface layer which is formed of a selected color to match the vehicle.

A weatherseal configuration of the composite strip incorporating the present invention includes a surface layer of an expanded thermoplastic, wherein an entire thickness of the surface layer is expanded. The expanded thermoplastic is typically located on a decorative or trim portion of the weatherseal. That is, a portion of the weatherseal that does not form a sealing interface between the confronting surfaces. These decorative portions are often colored to match an adjacent portion of the confronting surface. However, it is understood the expanded thermoplastic surface layer may be located on a portion of the weatherseal that performs a sealing function. For example, the weatherseal may include a sponge bulb which forms a sealing structure, wherein the present expanded thermoplastic surface layer is located on the bulb to provide the desired aesthetic characteristics and a sufficient flexibility to avoid compromising the performance of the weatherseal.

In a first configuration, the expanded surface layer has an original cellular structure which has been mechanically deformed. The deformation reduces the volume of a multitude of cells to less than their original volume. A typical deformation of the expanded thermoplastic is performed in an embossing process. That is, the expanded thermoplastic of the surface layer is at least locally densified. The local densification may be located at separate areas or portions of the expanded thermoplastic surface layer.

In one construction, the present composite strip provides a weatherseal having an elastomeric substrate with a decorative or trim portion covered by an expanded thermoplastic surface layer. The substrate may be any of a variety of constructions and materials including thermosets, thermoplastics or composites, with or without reinforcing. The expanded thermoplastic surface layer is formed with an initial cellular structure. In certain applications, the original cellular structure is maintained in the final product. In alternative configurations, the original cellular structure is densified. The expanded densified thermoplastic surface layer can be located on seals, bulbs, lips sponge or solid material.

The present expanded thermoplastic surface layer provides increased flexibility over prior composite extrusions. Prior applications of a thermoplastic to a rubber substrate increased the rigidity of the resulting composite. In contrast, the

present expanded thermoplastic is configured to enhance the flexibility of the resulting weatherseal. The increased flexibility allows the seal to conform to the relevant confronting surface, such as a vehicle body, thereby easing installation procedures. In addition, the present expanded thermoplastic surface layer has been found to accept a higher degree of embossing, than surface layers that have not been expanded. The expanded thermoplastic surface layer provides a reduced coefficient of friction as well as noise deadening.

Brief Description of the Drawings

Figure 1 is a perspective view of an automobile employing the present weatherseals.

Figure 2 is a cross sectional view of a first weatherseal showing a first location of the present surface layer.

Figure 3 is a cross sectional view of a first weatherseal showing a second location of the present surface layer.

Figure 4 is a cross sectional view of a first weatherseal showing a third location of the present surface layer.

Figure 5 is a cross sectional view of a second weatherseal showing a first location of the present surface layer.

Figure 6 is a cross sectional view of a second weatherseal showing a second location of the present surface layer.

Figure 7 is a cross sectional view of a second weatherseal showing a third location of the present surface layer.

Figure 8 is a cross sectional view of a third seal showing the present surface layer.

Figure 9 is a cross sectional view of a further seal showing the present surface layer.

Figure 10 is schematic view of a processing line for forming the present weatherseal.

Figure 11 an enlarged cross sectional view of a weatherseal showing the cellular structure in the expanded surface layer prior to deformation.

Figure 12 an enlarged cross sectional view of the weatherseal showing the

cellular structure in the expanded surface layer after deformation.

Figure 13 an enlarged cross sectional view of a weatherseal showing an alternative cellular structure in the expanded surface layer prior to deformation.

Figure 14 an enlarged cross sectional view of the weatherseal showing the alternative cellular structure in the expanded surface layer after deformation.

Figure 15 is graph showing a relationship of surface layer density to percentage expanding mixture.

Detailed Description of the Preferred Embodiments

The composite strip 10 of the present invention can be employed in motor vehicles 12 as shown in Figure 1. The composite strip 10 can be used in locations as a weatherseal for releasably and repeatedly engaging a panel 14. For purposes of description, the present composite strip will be described in terms of a weatherseal employed in a motor vehicle; however, it is understood the present invention is not limited to this particular application which requires a resistance to environmental migration along an interface.

The term composite "strip" includes, but not is not limited to extrusions, moldings, trim, trim pieces, edge pieces, weatherseals and seals. The present composite strip may be used as a weatherseal in structural sealing applications including residential and commercial buildings as well as the motor vehicle industry. In the motor vehicle industry, a weatherseal configuration of the present strip is suitable for use in many areas including, but not limited to, door seals, roof rails, deck lids, hood to cowl seals, window seals, sun roof seals or window channel seals. In particular, the present invention finds application in combined seal and edge trims, wherein a weatherseal includes a trim portion having the expanded thermoplastic surface layer which is formed of a selected color to match the vehicle 12.

The panel 14 may be any of a variety of materials and does not limit the present invention. For example, the panel 14 may be glass, metal or a composite, which is painted, surface treated or bare. In the operating environment, the panel 14 is brought repeatedly into and out of engagement with the weatherseal 10. The engagement of the panel 14 and the weatherseal 10 may result from motion of the panel relative to the weatherseal. Alternatively, the weatherseal 10 may be moved

relative to the panel 14. Further, the seal 10 and the panel 14 may be oriented to substantially preclude unintended movement. For example, the seal 10 may be located about a fixed panel 14 such as a front or a rear window.

The weatherseal 10 of the present invention includes a substrate 40 and a surface layer 60, wherein the surface layer may define an area of contact between the weatherseal and the panel 14, or merely form an outer surface of the seal.

The substrate 40 forms a base upon which the surface layer 60 is disposed and may be formed of a variety of materials including thermoplastic or thermosetting materials, including but not limited to TPE, EPDM or any combination thereof. Suitable vulcanized or cross-linked (thermosetting) polymeric materials include the EPDM, EPDM modified with chlorobutyl, nitrile modified EPDM, polyethylene, ethylene vinyl acetate or polypropylene.

The substrate 40 may have a relatively rigid portion and a relative soft portion. The substrate 40 may include a reinforcing member 43 such as a wire or metal carrier, which may be of known construction (e.g. knitted wire, slotted or stamped metal). It is contemplated, the substrate 40 may include a thermoplastic portion and a thermoset portion each having a unique rigidity, wherein the thermoplastic portion typically increases the rigidity of the weatherseal 10. In addition, the substrate 40 may be formed of differing thickness to provide differing amounts of rigidity. The substrate 40 may have any of a variety of cross sections. For example, the cross-section profile may be generally "U" shaped, "J" shaped, "L" shaped or planar.

The substrate 40 includes contact surfaces that abut or contact the panel 14. The substrate 40 also includes exterior, or trim portions 80 which do not contact the panel. Typically, the exposed exterior surface 80 functions as trim. That is, the substrate 40 includes a decorative or trim portion which does not provide a sealing function with the panel 14. Thus, the trim portion may be used to hide or overlie a function portion of the substrate 40. Therefore, it is often desirable for the trim portion to have a different color than the underlying substrate 40 or portion of the substrate performing the sealing function. As seen in Figures 2-7, the substrate 40 may also include sponge or foam portions such as bulb 44 for contacting and sealing

against the panel 14.

The portion of the substrate 40 upon which the surface layer 60 is located is usually a decorative or trim portion. The decorative or trim portion often has a different finish, texture or color than panel contacting portions of the weatherseal. Therefore, the surface layer 60 may be located on the trim portions of the weatherseal. However, it is understood the surface layer 60 may be located on a panel contacting portion of the weatherseal. When the surface layer 60 is located on a portion of the substrate 40 that performs a sealing function, the underlying substrate is typically a foamed or expanded material. Thus, the expanded thermoplastic surface layer 60 may be located on a sponge portion of the substrate 40.

The surface layer 60 is sufficiently connected to the substrate 40 to preclude unintended separation during operation. The surface layer 60 may be connected to the substrate 40 by mechanical or chemical bonding, such as heat bonding or adhesives. For reducing costs, it is preferred the surface layer 60 is bonded to the substrate 40 without requiring adhesives. While the surface layer 60 may have a variety of thicknesses, the thickness is at least partially dictated by the operating parameters of the weatherseal 10 and substrate 40. A typical range of thicknesses of the surface layer 40 is approximately 1 mm to approximately 6 mm, with a typical nominal thickness of approximately 3-mm. The surface layer 60 extends along the entire length of the weatherseal 10 and thus has the same length as the substrate 40.

The surface layer 60 is an expanded thermoplastic material, and preferably, an olefinic material. It is understood the surface layer 60 may include various fillers or additives and retain its thermoplastic nature. Preferably, the thermoplastic of the surface layer 60 has a melting temperature which is less than the melting temperature or degradation temperature of the substrate 40. The thermoplastic description of the surface layer 60 includes thermoplastic elastomers (TPEs). Thermoplastic elastomers are a unique class of thermoplastic engineering materials. They are based on several different polymer and polymer blend types that provide rubber-like (elastomer) properties in a material that can be processed on conventional thermoplastic processing equipment. These physical properties are provided in a material that is processable at elevated temperatures and can be reheated and reprocessed as any

thermoplastic material.

Some of the expandable thermoplastic materials which can be used are based upon olefinic TPEs. The available range of materials includes polyethylene, polypropylene, or ethylene vinyl acetate. These can be modified with EPDM or butyl compounds and cross-linked by peroxides or moisture or other systems. The usual range of fillers and extenders like calcium carbonate, mica, talc and plastizisers can also be incorporated therein. The polyethylene, polypropylene or ethylene vinyl acetate can be modified with EPDM or butyl compounds and cross-linked by peroxides, moisture, radiation or other systems.

A preferred expandable thermoplastic elastomer is UNIPRENE® TPE sold by Teknor Apex of Pawtucket, Rhode Island. UNIPRENE® TPE is a specially designed thermoplastic vulcanizate which performs like cured rubber, but processes with the speed of thermoplastic olefins. Alternatively, the expandable thermoplastics material may be a blend of 90% Santoprene/10% polypropylene (or in any other ratio), or 100% Ethylene Vinyl Acetate (EVA), or a blend of the two. The expandable thermoplastic can be of any desired color. The thermoplastic of the surface layer 60 provides enhanced weathering capability and color fastness.

As shown in Figures 11 and 13, the thermoplastic of the surface layer 60 is expanded to have an original cellular structure. Thus, for a given thickness, the surface layer 60 requires less material than an un-expanded material. The surface layer 60 has a multitude of cells or voids 61 located throughout the thickness of the material. In a first configuration of the weatherseal 10, the surface layer 60 substantially retains the original cellular structure.

In an alternative configuration of the weatherseal 10, the original cellular structure of the expanded thermoplastic is modified. Specifically, the original cellular structure of the foamed thermoplastic is collapsed or compressed. The modified cells then exhibit an altered structure as shown in Figures 12 and 14. The modification of the cellular structure is performed to substantially avoid joining or bonding opposing portions of the cell wall. That is, the cell is reconfigured rather than obliterated.

It has been found advantageous for the expanded surface layer to have an

original cell structure wherein the individual cells have a relatively large cell volume which is substantially reduced for the finished seal. That is, rather than form a cellular structure having a multitude of relatively small cells, wherein no or little change in cell volume occurs upon deformation, it is preferred to form an original cell structure of relatively large cell volumes, wherein the original cell volumes are substantially reduced by deformation. A preferred seal construction reduces the volume of the original expanded material by approximately 20 to 80 percent. A representative amount of compression of the expanded thermoplastic is illustrated in a comparison between Figures 11 and 12. That is, Figure 11 and 12 are of the same magnification and scale, and depict the surface layer 60 before and after an embossing surface treatment respectively. Similarly, Figures 13 and 14 show the surface layer 60 before and after embossing respectively, at the same magnification and scale.

In a preferred construction of the weatherseal 10, the surface layer 60 is embossed. The embossed surface layer 60 compresses the original cellular structure of the surface layer. It has been found the expanded thermoplastic of the surface layer 60 accepts a greater degree of embossing than an un-expanded thermoplastic surface layer. That is, an embossed expanded thermoplastic surface layer 60 exhibits a deeper penetration for a given surface treatment than an un-expanded thermoplastic subjected to the same surface treatment.

Referring to Figures 2-4, a generally U-shaped edge trim profile weatherseal 10 is shown. The weatherseal 10 has a U-shaped body 40 formed of TPE or EPDM. However, it is understood SBR, a blend of the TPE and EPDM, natural rubber, neoprene or another thermosetting material may be used. The body 40 is formed with a plurality of small and large flange gripper fins 42 of any desired number and configuration, a hollow sealing bulb 44, a flap seal 46, and a secondary seal with subsidiary sealing fin 48. The bulb 44, the lip 46 and the fin 48 are formed of a sponged rubber in known manner. Located within the U-shaped body is the reinforcing member 43. The lip 46 and the outside surface of the closed end of the U shaped substrate 40 do not perform any sealing function with respect to the panel 14 and is thus a trim portion. These trim portions are preferably of a different color than

the substrate 40. The color is selected to match the vehicle or the building. It is desirable to provide a weatherseal 10 having lasting color (color fastness) for the least cost. As the surface layer 60 requires less material than the substrate 40 and can be formed of a material having greater color fastness than the substrate, the surface layer is often a different color than the substrate.

As shown in Figures 2-4, the expanded thermoplastic surface layer 60 may be located on the flap seal 46, the bulb 44 or the flap seal and the bulb. The expanded thermoplastic surface layer 60 can be embossed or unembossed. In prior constructions, the presence of a thermoplastic on sealing portion of the weatherseal, such as the deformable bulb, would have substantially reduced the effectiveness of the bulb. That is, the stiffness of the thermoplastic would have so reduced the flexibility of the bulb, that the bulb would not be able to sufficiently deform to form the necessary seal. In contrast, the present flexible expanded thermoplastic surface layer 60 is sufficiently flexible to permit its location on deformable seal portions such as the bulb, without interfering with the sealing performance.

Referring to Figures 5-7, an alternative configuration of a generally U-shaped edge trim profile weatherseal 10 is shown. The weatherseal 10 has a U-shaped body 40 formed of TPE or EPDM. However, it is understood SBR, a blend of the TPE and EPDM, natural rubber, neoprene or another thermosetting material may be employed. The body 40 is formed with a plurality of small and large flange gripper fins 42 of any desired number and configuration, a hollow sealing bulb 44 and a secondary seal with subsidiary sealing fin 48. The bulb 44 and the fin 48 are formed of a sponged rubber in known manner, and the tip of the outermost one of the larger of the fins may also be sponged. Located within the U-shaped body is the reinforcing member 43. As shown in Figures 5-7, the expanded thermoplastic surface layer 60 may be located on the outside of the U shaped portion, the bulb 44 or the outside of the U shaped portion and the bulb. Again, the present expanded thermoplastic surface layer 60 is sufficiently flexible to be located on the sponge sealing structure without precluding sufficient deformation of the sealing structure during operation.

Referring to Figure 8, a glass run is shown with the surface layer 60 located at non-panel contacting portions of the substrate 40.

For those configurations of the composite strip 10 having the expanded thermoplastic surface layer 60 at a panel contacting location, it has been found the expanded thermoplastic surface layer may reduce the coefficient of friction between the panel 14 and the strip 10. Specifically, the expanded thermoplastic surface layer 60 may be processed to exhibit a sufficient surface contours or roughness that reduces the coefficient of friction. The formation of the friction reducing surface contours may be provided while substantially maintaining the original cellular structure of the expanded thermoplastic. Alternatively, the friction reducing contours may be formed with a substantial compression of the original cellular structure. The surface contours may be any of a variety of configurations including, but not limited to, waves, crests, undulations, grooves, furrows, waffle patterns as well as geometric shapes or patterns.

In addition, the expanded thermoplastic of the surface layer 60 reduces noise generation upon relative motion between the strip 10 and the panel 14. Again, the particular surface contour that best reduces noise, such squeak or itch generation, is at least partially determined by the particular materials of the surface layer 60, the substrate 40 and the panel 14. In addition, the operating conditions such as temperature and compression pressures may at least partially determine the necessary surface contours to reduce noise generation. As previously stated the surface contours may have any of a variety of configurations.

Method of Manufacture

Referring to Figures 2-4 and 10, the generally U-shaped edge trim is formed by passing a dense EPDM from a first extruder 100 and a sponge EPDM from a second extruder 103 through a cross head extrusion die 110 to form the body. Typical temperatures for the cross head die 110 are between approximately 71°C and approximately 104°C.

The body then passes to a curing bed 116. The temperature of the curing bed 116 is determined by a number of processing considerations such as type of material, thickness of material, line speed, and type of curing medium. The cured body then passes to a cooling station or tank 120 and a hugger 125.

The body is then reheated in pre-heater 127 to a sufficient temperature to

ensure bonding to the thermoplastic from extruder 105, and passes through a second cross head die 130 where the expanded thermoplastic is presented from the thermoplastic (TP) extruder 105. Although subject to the various parameters previously discussed, a typical temperature range for the cross head die 130 is from approximately 160°C to approximately 220°C. The expanded thermoplastic is thus located on the body. The strip then passes to an embosser (if desired) and a surface contour is formed in the expanded surface layer. The strip is then passed to a cooling tank 150, where there is sufficient cooling of the expanded surface layer to retain the desired amount of the surface contours. The strip then passes to a second hugger 125 and to a post forming station 160, where the strip may be formed to the final cross sectional shape.

In the thermoplastic extruder 105, the thermoplastic material of the surface layer 60 may be combined with a blowing agent such as EXPANCEL® by Akzo Nobel to expand the material. The amount of blowing agent and resulting cellular structure is at least partially determined by the desired flexibility and aesthetic appearance of the expanded surface layer 60. Typical amounts of blowing agents range from approximately 0.5% to 5% of the thermoplastic to be foamed. Referring to Figure 15, the dependence of the surface layer density to percentage blowing agent is shown.

Optionally, the surface layer 60 can be deformed by compressing the originally expanded material, prior to cooling so as to alter the cell structure by decreasing the cellular volume and increasing the density of the expanded material. The expanded thermoplastic material is thus densified. Typically, the deformation is accomplished by embossing the surface layer at station 140.

The thickness of the expanded surface layer 60 may be reduced by as little as 5 or 10% to as much as 80 to 90% of the original thickness. The amount or degree of compression is at least partially determined by the intended application of the seal 10.

It is also understood that after being cooled, the profile can be "post formed" to the required profile, and/or shaped by passing against rollers, and optionally a further embossing wheel. Furthermore, after cooling, a high gloss coating can be sprayed onto the thermoplastics material to improve its surface appearance, and its

scuff resistance.

Alternatively, the substrate can be normally cured and reeled, and in a subsequent operation, reheated to a sufficient temperature to ensure subsequent bonding to the thermoplastic, and then passed into the further die to have the expanded thermoplastic extruded onto it. The final steps would then be undertaken in a similar manner to those previously described. It has been found that a satisfactory bond can be achieved by taking a reeled thermosetting extrusion extruded up to two weeks earlier, provided it is heated adequately before passing it into the cross head die to meet the expanding thermoplastic.

Referring to the weatherseal of Figure 8, a strip which will eventually become a vehicle window guide channel is extruded from a thermosetting polymeric material such as EPDM in a traditional "rubber" extruder 100 shown in Figure 10. On emerging from the die 110, the body is passed through a standard curing tunnel 116. The vulcanized extrusion emerges from the tunnel 116 in a cured state.

The body is then passed into the second die 130, where the expanded thermoplastics material, ideally a TPE such as UNIPRENE®, is extruded onto trim or decorative portions of the still hot strip. Due to the residual heat of the thermosetting material of the substrate strip, and due to the fact that the temperature of the expanded thermoplastics material in the extruder is in the range of 140°C to 250°C, the thermosetting material of the composite strip and the expanded thermoplastic bond together.

Immediately on emerging from the die, the composite strip is passed through the cooling tank partially to cool the exposed surfaces of the thermoplastic surface layer, so that the surfaces are no longer tacky. Referring to Figures 11 and 13 , the expanded thermoplastic of the surface layer thus has an original cellular structure, thickness and hence density. The expanded thermoplastic of the surface layer 60 thus provides an exposed surface that is free of adhesives.

Optionally, the weatherseal 10 can then be passed through an embossing station 140 which contacts the expanded surface layer 60. During embossing, the cellular structure is deformed, as shown in Figures 12 and 14. This process increases the density of the surface layer 60 by collapsing and partially collapsing many of the

cells in the surface layer. The embossing may impart textured surface features to the surface layer, or alternatively may provide a relatively smooth surface.

By deforming the expanded surface layer 60 in a heated state, the cellular structure does not exhibit complete resiliency and thus a multitude of the cells retain the compressed profile thereby reducing the density of the surface layer. In collapsing a portion of the cellular structure, the walls of a given cell may contact. However, the processing temperature is selected such that the contacting walls do not bond, adhere or join to each other.

The substrate 40 and embossed expanded surface layer 60 are then fed into the cooling tank 150. The extrusion is then cooled virtually to room temperature.

The strip of Figure 8 is designed to act as a guide for a sliding window, with the expanded thermoplastic having a color selected surface on a trim portion of the weatherseal 10.

Referring to Figure 9, the weatherseal is formed in a similar manner to the profiles of Figures 2-8. That is, the substrate 40 is extruded and at least partially cured. Preferably, while the substrate 40 is still hot, the expanded thermoplastic surface layer 60 is extruded onto an exterior surface 80, such as a trim portion of the substrate 40.

It will of course be appreciated that while the substrate 40 is formed of a thermosetting black rubber material, the portions formed of the expanded thermoplastics material can be of any desired color (e.g. to color match a vehicle's paint work) and exhibit the enhanced flexibility. In addition, the expanded thermoplastic surface layer 60 provides the weathering resistance and color retention characteristics of a thermoplastic.

Therefore, the method of the present invention encompasses forming a composite extrusion having a main body portion having at least principally of one or more thermosetting polymeric materials and at least one surface portion of an expanded thermoplastic polymeric material, comprises the steps of passing one or more thermosetting materials through a die to form the substrate or main body portion, at least partially curing the body portion, maintaining the body portion at an elevated temperature, passing the same, while hot, through a further die and extruding

an expanded thermoplastic material onto a portion thereof (such as a decorative or trim portion), thereby bonding the two materials together, and then cooling the composite extrusion.

It is also understood that depending upon the selection of the materials, the expanded thermoplastic can be extruded simultaneously or subsequent to an extrusion of the substrate 40. Specifically, for those TPE substrates not requiring a curing temperature, the expanded thermoplastic surface layer 60 may be disposed onto the substrate at the extrusion of the substrate.

It is understood the surface layer 60 may be surface treated, with or without compression by any of a variety of methods including, but not limited to, air jets, water jets, electrical impulses embossing, media impacting, sand blasting, or chemical treatment.

Thus, the present invention provides a composite weatherseal 10 having enhanced flexibility to better follow the contours of the vehicle as well as aid in the installation process. That is, the expanded thermoplastic has a greater flexibility than a corresponding un-expanded thermoplastic and by employing the expanded thermoplastic as a surface layer 60 of the seal 10, the seal more nearly functions as a single durometer seal rather than a multi-durometer seal. The present configuration obtains the advantage of color fastness of a thermoplastic, while providing a softer hand feeling similar to a rubber. Also, the expanded surface layer readily takes embossing, thereby enhancing the appearance of the weatherseal.

It will of course be understood that the various embodiments of the present invention have been described above purely by way of example, and modifications of detail can be made within the scope of the invention..

In the Claims:

1. A composite strip for operable location in a given environment and having a given length, the composite strip comprising an expanded thermoplastic layer extending the length of the composite strip, the expanded thermoplastic being a color selected to match the given environment.

2. The composite strip of Claim 1, wherein the expanded thermoplastic layer includes a thermoplastic elastomer.

3. The composite strip of Claim 1, further comprising a substrate supporting the expanded thermoplastic.

4. The composite strip of Claim 3, wherein the substrate is rubber.

5. The composite strip of Claim 1, wherein the expanded thermoplastic layer is embossed.

6. The composite strip of Claim 3, further comprising a reinforcing member attached to the substrate.

7. The composite strip of Claim 6, wherein the reinforcing member is a metal carrier or a thermoplastic.

8 The composite strip of Claim 1, wherein the expanded thermoplastic layer has a cellular structure.

9. The composite strip of Claim 1, wherein the expanded thermoplastic layer has a compressed cellular structure.

10. A composite strip having a seal portion and a trim portion, the composite strip comprising an expanded thermoplastic surface layer on the trim portion.

11. The composite strip of Claim 10, wherein the expanded thermoplastic surface layer is a different color than the substrate.

12. The composite strip of Claim 10, wherein the seal portion is one of thermoplastic or a thermosetting material.

13. The composite strip of Claim 10, wherein the expanded thermoplastic surface layer has a partially collapsed cellular structure.

15. A composite strip, comprising:

(a) a substrate of a first color; and

(b) an expanded thermoplastic layer extending the length of the weatherseal, the expanded thermoplastic being a second color different than the first color.

16. The composite strip of Claim 15, wherein the substrate includes a trim portion and the expanded thermoplastic layer is located on the trim portion.

17. The composite strip of Claim 15, wherein the expanded thermoplastic has a compressed cellular structure.

18. The composite strip of Claim 15, wherein the second color is selected to match an operating environment of the weatherseal.

19. The composite strip of Claim 15, wherein the substrate includes a sponge sealing structure, and the expanded thermoplastic is located on the sealing structure.

20. A composite strip for providing an interface between confronting surfaces, the composite strip having a cellular sealing structure, the composite strip comprising an expanded thermoplastic surface layer on the cellular sealing structure.

21. The composite strip of Claim 20, wherein the surface layer is different color than the sealing structure.

22. A composite strip comprising a layer having a compressed cellular structure.

23. The composite strip of Claim 22, further comprising a substrate attached to the

surface layer.

24. The composite strip of Claim 23, wherein the surface layer has a different color than the substrate.

25. The composite strip of Claim 22, wherein the substrate includes a trim portion and the surface layer is located on the trim portion.

26. The composite strip of Claim 22, wherein the compressed cellular structure forms a surface layer.

27. A composite strip for contacting a panel in an automotive vehicle, the strip comprising:

(a) a substrate; and

(b) an expanded thermoplastic layer on the substrate located to contact the panel, the expanded thermoplastic layer selected to substantially preclude noise generation upon relative movement between the panel and the expanded thermoplastic layer.

28. The composite strip of Claim 27, wherein the expanded thermoplastic layer has a compressed cellular structure.

29. The composite strip of Claim 27 wherein the expanded thermoplastic layer is surface treated.

30. A composite strip for contacting a panel in an automotive vehicle, the strip comprising:

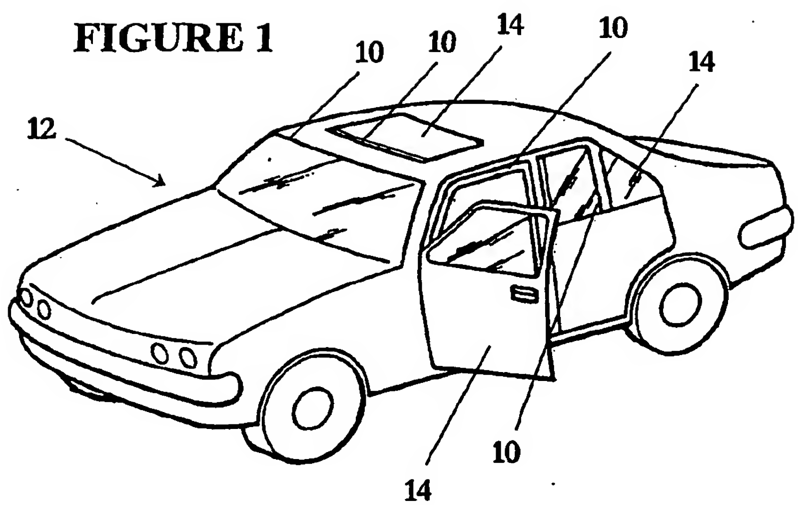
(a) a substrate; and

(b) an expanded thermoplastic layer on the substrate located to contact the panel, the expanded thermoplastic layer having a lower coefficient of friction than an unexpanded layer of the same thermoplastic material.

31. The composite strip of Claim 30, wherein the expanded thermoplastic layer has a compressed cellular structure.

32. The composite strip of Claim 30, wherein the expanded thermoplastic layer is surface treated.

FIGURE 1



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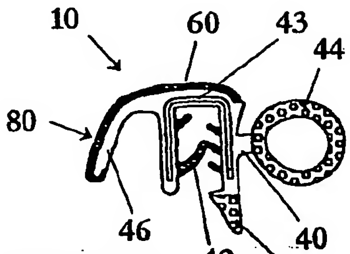


FIGURE 2

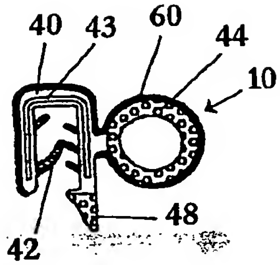
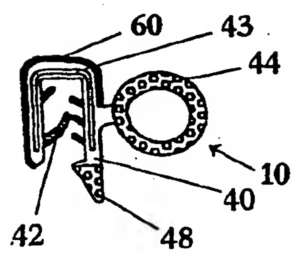


FIGURE 5

FIGURE 6



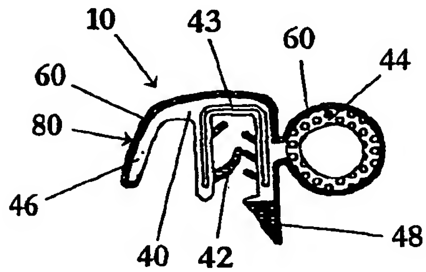


FIGURE 3

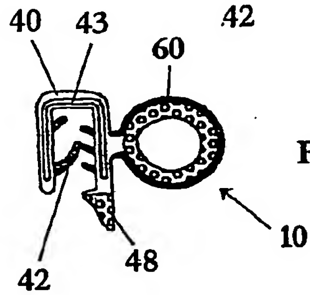


FIGURE 7

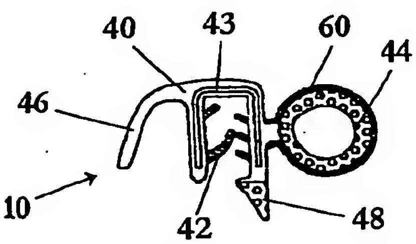


FIGURE 4

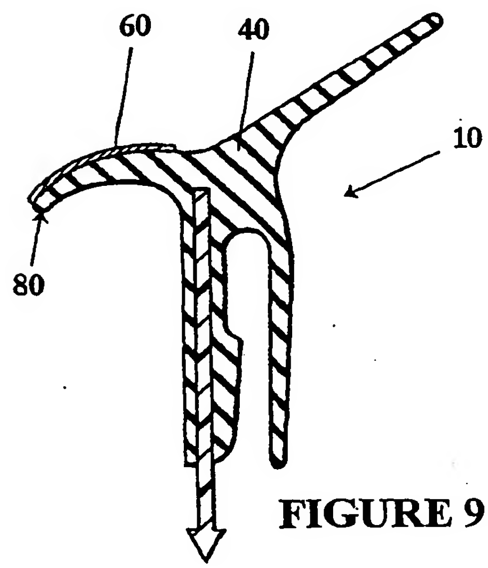


FIGURE 9

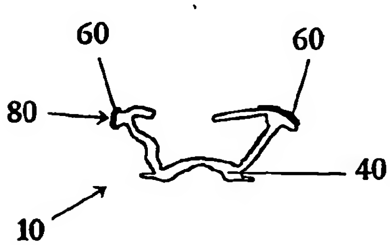


FIGURE 8

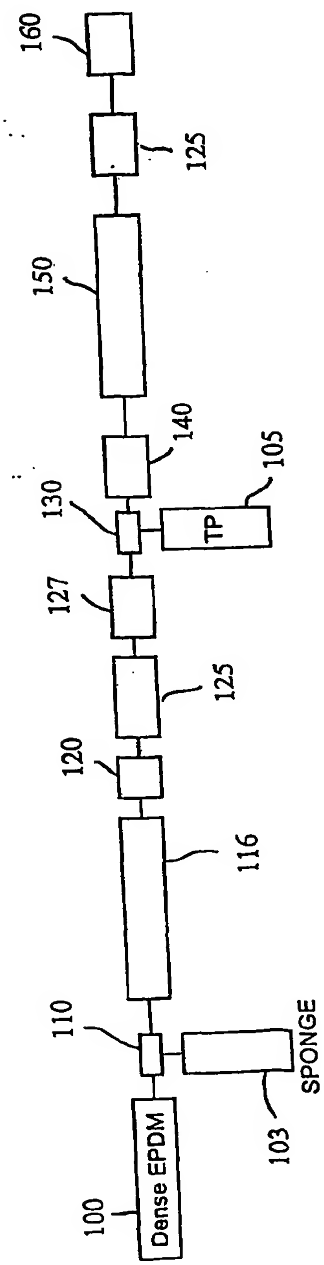


FIGURE 10

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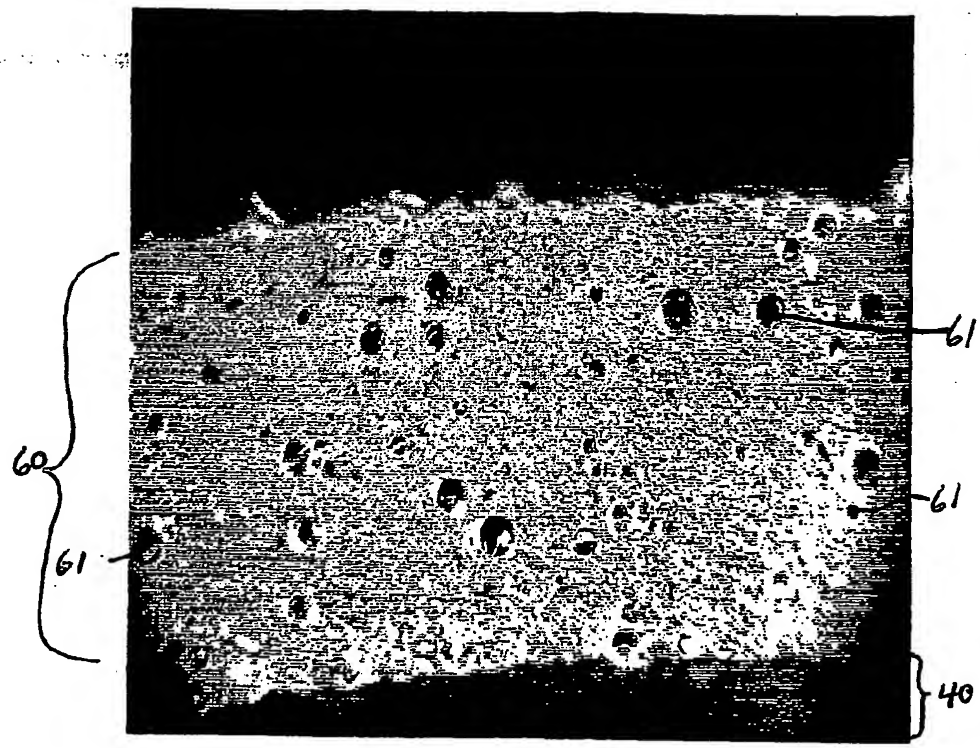
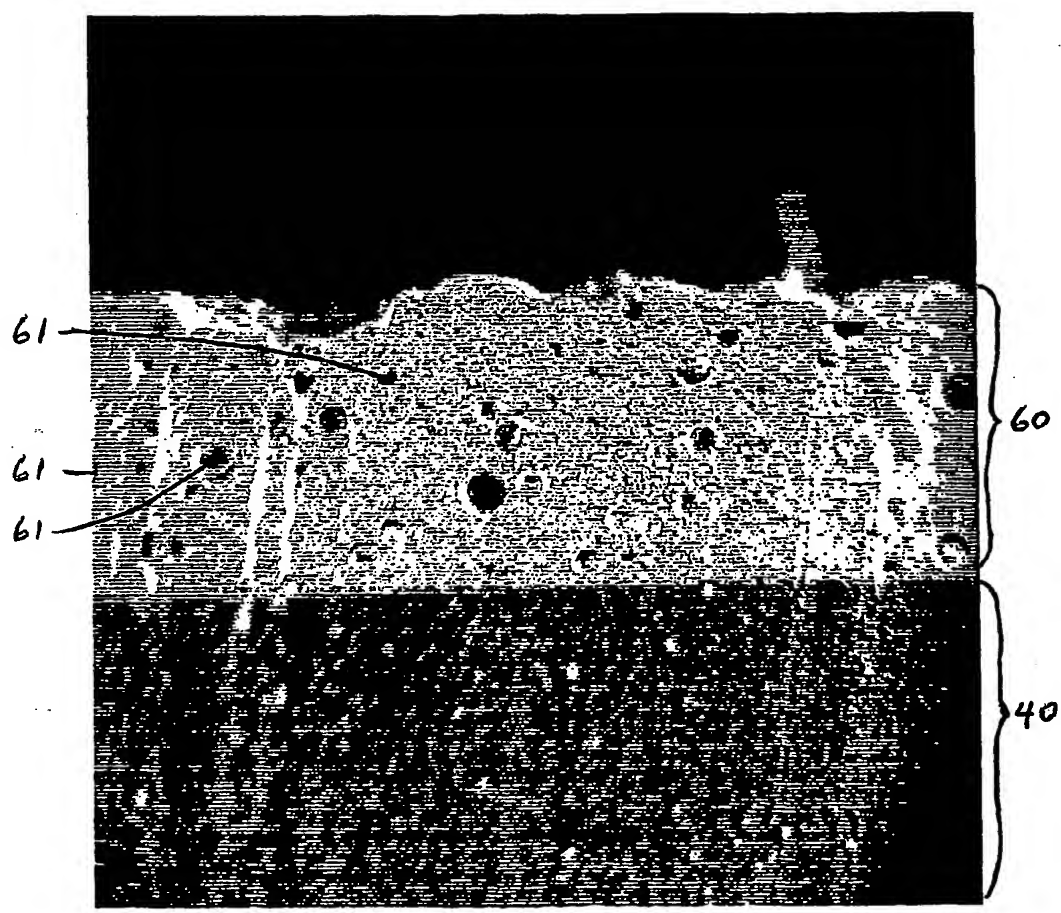


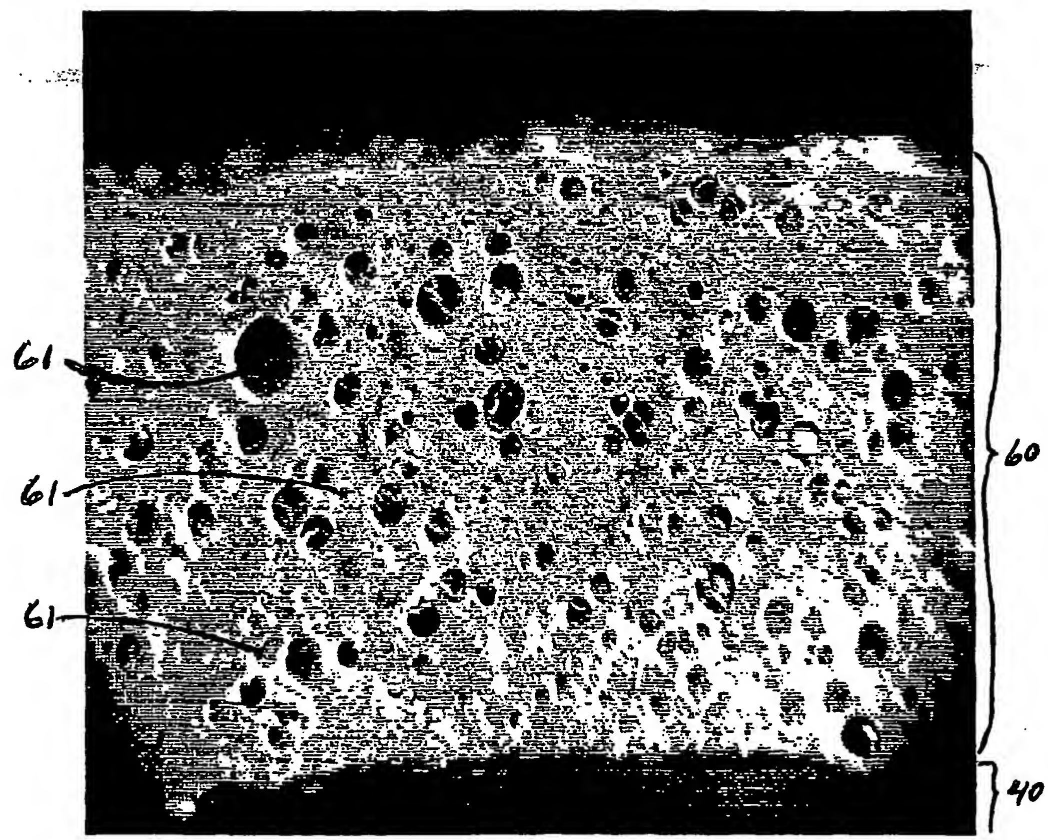
.7 % blowing agent
foamed

Figure 11



.7% blowing agent
embossed

Figure 12



2.0% blowing agent
foamed

Figure 13

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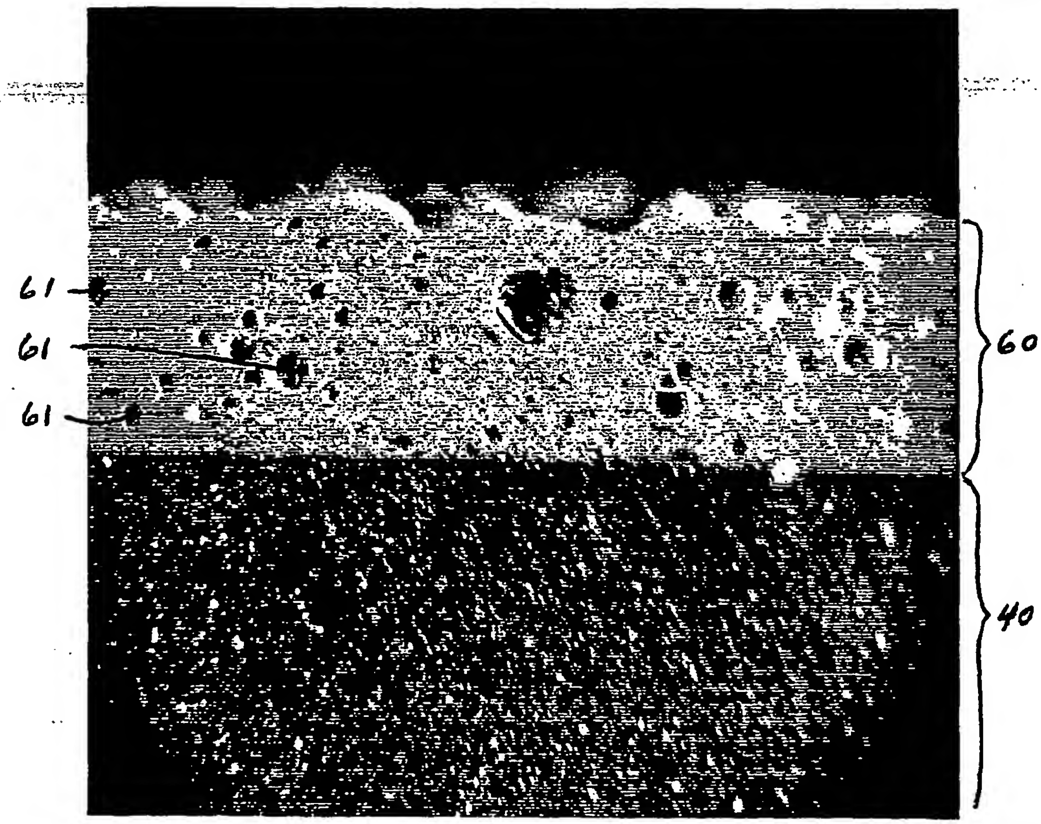
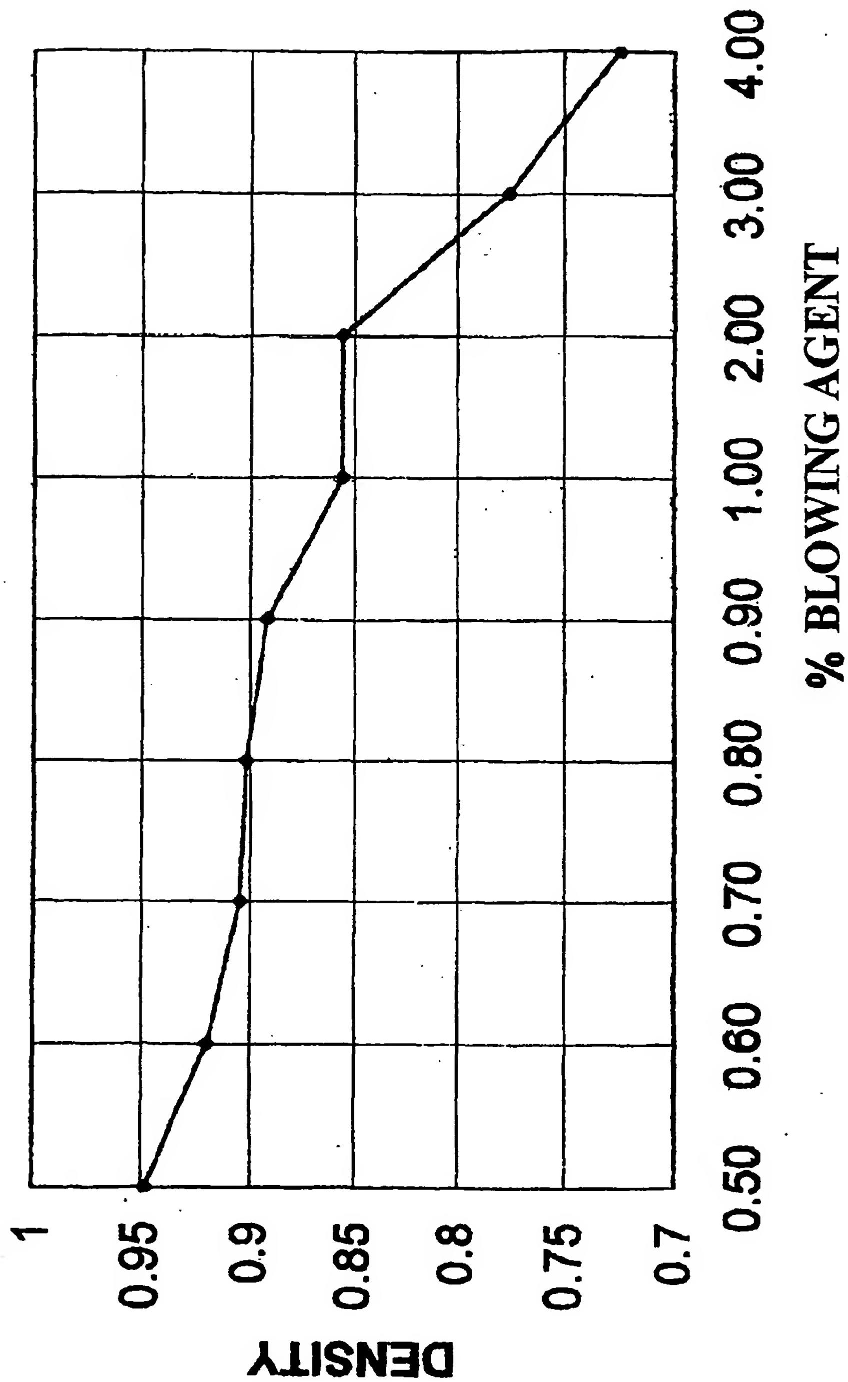


2.0% blowing agent
embossed

Figure 14

FIGURE 15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0.85
0.8
0.75
0.7
% BLOWING AGENT
0.50
0.60
0.70
0.80
0.90
1.00
2.00
3.00
4.00